MATH5715 – Course Outline

Information about the course

Course Authority:  Associate Professor Ian Doust
Lecturer:  Ian Doust  RC-6113, email i.doust@unsw.edu.au.
Consultation:  Please use email to arrange an appointment.

Credit & Prerequisites:

This course counts for 6 Units of Credit (6UOC).

This course is usually taken by Honours students and coursework Masters students. Very well-prepared third year students might be admitted after approval by A/Prof Doust — see him if you are interested.

The course will assume a familiarity with some of the basic notions of analysis and (to a lesser extent) algebra. Students who have done MATH5605 Functional Analysis and a first course in group theory should be well-prepared. Although we won’t need too much about the structure of Hilbert and Banach spaces, you should at least know what these are. Some basic knowledge of measure and integration will be useful.

Lectures:  TBA — come to the timetabling meeting!
On-line:  I will probably NOT be using the BlackBoard page for this course.

Course aims

Harmonic analysis is a very large and varied subject. Our aim here will be to get some appreciation of the breadth of mathematics that it encompasses, and then to look in more detail at a couple of important topics. The first of these will be to development a general setting with which we can collect some of the results about Fourier series (on the circle) and Fourier transforms (on the real line) into a single framework.

In the second half of the course we shall return to a consideration what happens in the classical settings. We shall see how many of the important problems in analysis can be viewed as questions about the behaviour of particular types of operators known as Fourier multipliers. Our aim will be to look at some of the main classical theorems about the boundedness of these operators on $L^p$ spaces.
Course schedule

The actual path we shall take through the material will depend a little on the background and progress of the participants. The following is my first guess at which way we shall head off:

2. A quick review of topology, measure, integration etc.
3. Locally compact abelian groups. Haar measure. Duality theory.
4. Fourier series and Fourier transforms.
5. Multipliers.

Assessment

Overview:

<table>
<thead>
<tr>
<th>Task</th>
<th>Due Date</th>
<th>Weighting</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>week 3</td>
<td>10%</td>
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<tr>
<td>Assignment 2</td>
<td>week 6</td>
<td>20%</td>
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<tr>
<td>Assignment 3</td>
<td>week 10</td>
<td>20%</td>
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<tr>
<td>Exam</td>
<td></td>
<td>50%</td>
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<tr>
<td>Total</td>
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<td>100%</td>
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**Assignments:** Assignments will give an opportunity for students to try their hand at more difficult problems requiring more than one line of argument and also introduce them to aspects of the subject which are not explicitly covered in lectures. We shall have one short assignment due early in the course to get you started and then two more substantial assignments due in weeks 6 and 10. (Assignments will be due at the start of the last lecture for that week.) Draconian late penalties will apply at the whim of the lecturer.

Exam: The final two hour examination will assess student mastery of the material covered in the lectures. The exam will be worth 50% of your final mark. Further details about the final examination will be available in class closer to the time.
Additional resources and support

Problem Sheets

A set of problem sheets will be given out. These problems are for you to do to enhance mastery of the course. Occasionally, if there is a demand and/or need for it we will have a problem class, doing some of the problems on the sheets.

Textbooks and other references

Unfortunately I don’t know of any good reference that covers all that we’ll do in this course. Be aware that some books on harmonic analysis may have very little overlap with this course!

A very standard reference that I’ll be using a good deal is

• Y. Katznelson, *An introduction to harmonic analysis*.

This book has appeared in various editions. You can probably pick up a second-hand copy of the Dover paperback version very cheaply ($15?).

It should be noted however that there is a good deal of material that I hope to cover which is not in this book.

Course Evaluation and Development

The School of Mathematics and Statistics evaluates each course each time it is run. We carefully consider the student responses and their implications for course development. It is common practice to discuss informally with students how the course and their mastery of it are progressing.

Student Learning Outcomes

Students taking this course will develop an appreciation of the basic concepts of Harmonic Analysis. This will include both an overview of the breadth of the subject as well as an appreciation of some of the techniques required for carefull work in this area of mathematics.

**Relation to graduate attributes:** The above outcomes are related to the development of the Science Faculty Graduate Attributes, in particular: 1. Research, inquiry and analytical thinking abilities, 4. Communication, 6. Information literacy
Teaching strategies underpinning the course

New ideas and skills are introduced and demonstrated in lectures and problem sessions, then students develop these skills by applying them to specific tasks in problem sheets and assessments.

Rationale for learning and teaching strategies

We believe that effective learning is best supported by a climate of inquiry, in which students are actively engaged in the learning process. Hence this course is structured with a strong emphasis on problem-solving tasks in assessment tasks, and students are expected to devote the majority of their class and study time to the solving of such tasks.

Rationale for Assignments: Assignments will give an opportunity for students to try their hand at more difficult problems requiring more than one line of argument and also introduce them to aspects of the subject which are not explicitly covered in lectures.

Rationale for Examinations: The final examination will assess student mastery of the material covered in the lectures.

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes outlined above.

Administrative matters

Additional Assessment

This is at
http://www.maths.unsw.edu.au/currentstudents/additional-assessment

School Rules and Regulations

Fuller details of the general rules regarding attendance, release of marks, special consideration etc are available via the School of Mathematics and Statistics Web page at
Plagiarism and academic honesty

Plagiarism is the presentation of the thoughts or work of another as one’s own. This does not preclude you from consulting references and discussing questions with other people. It just means that you need to be clear and honest about where the ideas came from. This can usually be covered by a sentence such as ‘This proof is based on one in . . . ’ or ‘The clever idea to consider random subsets of $\Gamma$ was provided by Fred’.

Obviously straight copying of someone else’s assignment is both unethical and easily detected. You should never provide your written solutions to another student; inevitably their work will look just like yours and you’ll both be penalized. If you work on a problem with a friend, make sure that you each write it up quite separately (and mention that you discussed the problem with your classmate). It is very easy to tell when someone has copied something and not understood it.

Serious cases of plagiarism will attract severe penalties.

You should consult the University web page on plagiarism. Issues you must be aware of regarding plagiarism and the university’s policies on academic honesty and plagiarism can be found at http://www.lc.unsw.edu.au/plagiarism and http://www.lc.unsw.edu.au/plagiarism/plagiarism_STUDENTBOOK.pdf.